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Formulation, Characterisation and In Vitro Evaluation of Herbosome Sunscreen Lotion

Research Article

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Abstract

Introduction: The global market for sunscreen ingredients is rising day by day. Herbosomes are essentially the substance encapsulated in liposomes, which are tiny vesicles with a lipid bilayer. The benefits lie in the enhanced bioavailability and targeted delivery of the active ingredients. Material and Methods: Herbosomes were prepared by using aloe vera and resveratrol in various ratios against phosphatidylcholine. Herbosomes of aloe vera and resveratrol were incorporated into the lotion. Two formulations, F1 and F2, of herbosome lotion were prepared. Results and Discussion: This study set out to develop and standardise herbosomal sunscreen lotion that has a significant sun protection factor and enticing qualities. The sunscreen lotions F1 and F2 were developed using two distinct ratios of aloe and resveratrol, and their physicochemical properties and SPF were also assessed. Herbosome lotion thus formed was evaluated for visualisation, homogeneity, viscosity, irritancy test, spreadability, and pH. The efficacy of the developed formulation, which possesses SPF in the range of 19 to 23, when tested with a standard, was observed to be satisfactory to that of a marketed sunscreen with SPF 55. Conclusion: In this research study, formulation F2 was found to have a higher SPF and be more stable and effective than formulation F1.

Keywords: Herbosome, Sunscreen, SPF, Standardisation, Encapsulation.

Introduction

According to sources, moderate sun exposure offers several positive effects; however, skin cancer, acute and chronic eye injuries are thought to be possible outcomes of prolonged UV exposure (1). There are publicly traded photo protective products available for skin, hair, and nails. Sunscreens are found in creams, moisturisers, gels, serums, sticks, sprays, and lip moisturisers. Photo protective products work by absorbing, reflecting, or scattering the UV rays, thus preventing them from penetrating the skin and causing damage (2). According to market research, the market for sun protection products is predicted to expand steadily through 2021, obtaining a market capitalisation of $15.3 billion in total. Sales are projected to increase at a 6.6% CAGR through 2031.

The advantages of sunscreen have reportedly been proven to protect the skin from the harmful effects of UV radiation, promote skin health, and reduce the risk of sun-related skin damage. Sun Protection Factor (SPF) is a common measure of a sunscreen's effectiveness along with UVA protection, persistent pigment darkening (PPD), and critical wavelength (range of UVA wavelengths). According to regulations issued by the Food and Drug Administration (FDA), marketed formulations must include SPF range on their labels, which indicate how long they will shield users from UV rays (3). Many cosmetic companies claim that high SPF numbers provide excellent sun protection. To increase the SPF value, multiple synthetic sunscreen agents are incorporated in the formulation, which leads to many allergic reactions (4,5). People consider herbal sunscreen products superior to chemical ones because they have fewer side effects, have more biological effects on the skin, and are more affordable (6,7).

Many studies on the effectiveness of several herbs for sun protection have been published. So many herbal sunscreen creams, lotions, and gels are available on the market with labelled sun protection factors [SPF]. Turmeric, Aloe vera, Sandalwood, Green tea, Jojoba oil, lavender, and other herbs that have a sun-protective factor are frequently utilised in herbal sunscreens along with other ingredients (8,9). These plants are already being explored for their antioxidative, anti-ageing, and anti-scavenging properties, etc (10). Natural substances derived from plants are currently being researched as possible sunscreen products due to their high UV light absorption and antioxidant effects. The current research intends to develop sunscreen lotions using a minimum number of herbal extracts such as *Aloe barbadensis* (Liliaceae) which have a broad spectrum of anti-UV radiation efficiency. Aloe Vera is a

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prominent ingredient in many commercial sunscreen creams because it protects the skin from UV rays (11).

Developing formulations with antioxidant and photoprotective activity is made more appealing by the addition of resveratrol, a chemically fat-soluble polyphenolic stilbene (12). Herbosomes improved ability to pass through lipid biomembranes and circulation makes them more accessible than plain herbal extract. It is a combination of phospholipids (phosphatidylcholine, phosphatidylserine, etc.) and naturally occurring active substances that improves the absorption of herbal extract (13).

Materials and Methods

The aloe vera leaves were collected from the garden (Sai Park, Near Sai mandir, Hinganghat). Resveratrol was purchased from HiMedia Ltd., India. All required chemicals were available at the institute of DRGIOP (Thermosil Fine Chemicals Pvt. Ltd.).

Instruments

A pH meter (Systronic, India), a viscometer (Brookfield Engineering Laboratories, United States) (DV-I, LV-I spindle), a homogeniser (Euro-Star), UV visible spectrophotometer (Shimadzu, Japan) were the tools utilized for the analysis.

Preparation of gel

The jelly substance was removed using a knife from aloe vera leaves, taking care to prevent extraneous debris from contaminating the jelly material. To get a gel-like consistency, the aloe vera jelly homogenised separately with a sufficient amount of tragacanth at 500 rpm and at room temperature.

Formulation of Herbosome

Herbosomes were prepared by adding aloe gel, resveratrol and synthetic agent phosphatidylcholine (PC) by solvent evaporation method. In this first beaker aloe gel, resveratrol and in another beaker, phosphatidylcholine was mixed with dichloromethane. Then both mixtures were mixed together and stirred well. After that, the reaction is allowed to be carried out at a temperature not exceeding 40°C for 3 hours to get the maximum possible yield and drug entrapment. The mixture was concentrated by solvent evaporation to obtain the precipitate, which was filtered and collected. Herbosomes were prepared in two different concentrations: 2% and 5% (14).

Formulation of sunscreen lotions

As shown in Table 1, the exact amounts of cetyl alcohol, zinc oxide, stearic acid, glycerin, and hydroxypropyl methylcellulose (HPMC) were measured and heated to make solution A. 80 mL of water was taken in a 500 mL beaker, and then 1 g of triethanolamine was added to it with continuous stirring. In the aqueous phase, the prepared herbosome was added at 2% w/w and 5% w/w as Formulations F1 and F2, respectively. Then this water mixture was subjected to a temperature range of 75–80 °C to make solution B. Once the temperature reaches 80°C, slowly add solution A to solution B with continuous stirring. Continued stirring was required so as to attain uniform consistency (17). The prepared herbosomal lotion was left to cool further. As an essence, rose oil was added at the end. Finally, rose oil was added as an essence. As a result, two formulations, F1 and F2, were created with varying amounts of the herbosome, as shown in Table 1.

Preparation of lotion containing herbosomes

Herbosome was added at 2% w/w and 5% w/w in the aqueous phase of the lotion as Formulation F1 and F2 respectively (15).

Evaluation of Formulation (15)

Physical Parameters

Appearance, colour and homogeneity are determined. Results are shown in the Table 02.

pH of the lotion

The pH meter was calibrated using a standard buffer solution. About 1 gram of the lotion was weighed and dissolved in 100 ml of distilled water, and its pH was measured.

Spreadability

Two standard-sized glass slides (20 × 5 cm) were chosen. One slide had the formulation on it. The other slide was positioned on top of the lotion so that the formulation was sandwiched between them at a distance of 7.5 cm, and 100 g of weight was distributed evenly to create a thin layer. After removing the weight, the extra cream that had stuck to the slides was scraped off. The two slides were positioned at a 45° angle and held there without any movement. The higher slide was allowed to fall off due to the force of weight attached to it, while the lower slide was held firmly in place by the clamps' opposing fangs. A 60-gram weight was attached to the upper slide. It was recorded how long it took the higher slide to move 5 cm apart from the lower slide in the weight-bearing direction. The three times the experiment was carried out, the mean for each of the three dimensions was determined. Final results were noted. The formula S = M*L/T is used to calculate the spreadability. Here, S stands for spreadability, L for glass slide length, M for weight attached to the higher slide, and T for time. The current experiment has L= 7.5 cm and M= 60 gram.

Thermal stability

In this experiment, the oil and lotion separation were evaluated in a humidity chamber with 60–70% relative humidity and 37±1°C. In this, a lotion stripe of 20 mm in width and 5 mm in height was applied to the interior wall of the 100 ml capacity chamber. The beaker was kept in the humidity chamber at 37 ± 1°C and 60–70% relative humidity for eight hours. There shouldn't be any oil separation in the lotion for the test to pass. The results are shown in the Table 02.

Viscosity

Viscosity was determined by Brookfield Viscometer II+ model using spindle no. 6 at a

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temperature of 30°C. The results were recorded after the viscometer showed a stable number.

Viscosity = Dial Reading × Factor.

For LV-4 at 6 RPM Factor is 1M (1000)

Measurement of UV absorption (In-vitro SPF)

Prepared formulations F1 and F2, respectively, were diluted with ethanol and further filtered. After sample preparation, each sample was scanned once every 5 nm at a wavelength in the UV region between 290 and 320 nm. (20,21). The Mansur equation was used to determine the SPF values after each measurement. The equation is as follows: (16)

Where: EE – Erythemal effect spectrum;
I–Solar intensity spectrum;
Abs – Absorbance of sunscreen product;
CF – correction factor (= 10).

Table 1: Composition of herbosome sunscreen lotion

Sr. No.	Ingredients	Quantity taken	
		F1	F2
1	Cetyl alcohol	2	2
2	Zinc oxide	12	12
3	Stearic acid	4	4
4	Glycerin	2	2
5	Hydroxy propyl methyl cellulose (HPMC)	10	10
6	Vitamin E	1	1
7	Triethanolamine	1	1
8	Propyl paraben	0.50	0.50
9	Herbosome	2	5
10	Rose oil	Quantity sufficient	Quantity sufficient
11	Distilled water	95 ml	95 ml

Result & Discussions

Evaluation of herbosome lotion

Table No. 2 lists the outcomes of the examination of the physicochemical parameters for the F1 and F2 formulations, respectively. Two formulations were developed, and it was found that they were both homogenous. Freshly prepared F1 and F2, both lotions, were pale yellow. The pH of the F1 and F2 lotions ranged from 06.0 to 07.0, comparable to the pH range of 4.5-7 of human skin. So, if applied to the skin, the two lotions would not cause irritation. According to this investigation, F1 and F2 had viscosities between 2,000 and 50,000 cps, which were acceptable for sunscreen compositions. The therapeutic potential of a lotion formulation depends on its spreadability, which describes how far a lotion distributes when applied to skin. In this study, the lotions F1 and F2 had good spreadability in the range shown below in the table 2. As shown in Table 3, the SPF values of both formulations were calculated. The SPF values of formulations F1 and F2 were found to be 19.43 and 25.53, respectively. Marketed sunscreen generally has a 15–50 SPF value. Results indicate that F2 showed a good SPF value, which is sufficient for protection against sun rays for a few hours.

Table 2: Physicochemical parameters of prepared herbosome sunscreen lotion

Sr. No.	Test parameters	Formulations		Standard range
		F1	F2	
1	Appearance	Pale yellow colour	Pale yellow colour	
2	pH	5.69	6.49	5.0-7.5
3	Homogeneity	Homogenous (Smooth)	Homogenous (Smooth)	Compile to Homogeneity
4	Viscosity	35000 cps	38000 cps	2000-50000
5	Thermal stability	No phase separation occurs	No phase separation occurs	Should not be phase separation at RH and temperature
6	Spreadability	21.42 g.cm/s	20.78 g.cm/s	9.0-31.02 g.cm/s
7	SPF	19.43	23.53	30 (Should NLT 30)

Table 3: SPF value for formulated herbal sunscreen lotion

Wavelength nm	EE (λ) X I (λ) employed	Absorbance (For F-1)	Absorbance (For F-2)
290	0.0150	2.097	2.099
295	0.0817	2.134	2.137
300	0.2874	2.264	2.268
305	0.3278	2.500	2.503
310	0.1864	2.500	2.500
315	0.0837	2.500	2.500
320	0.0180	2.500	2.500

SPF Calculation:

For F-1:

SPF = 10 x [0.0150 x 2.097 + 0.0817 x 2.134 + 0.2874 x 2.264 + 0.3278 x 2.500 + 0.1864 x 2.500 + 0.0837 x 2.500 + 0.0180 x 2.500]

= 10 x [0.031455 + 0.1743478 + 0.198736 + 2.500 (0.3278 + 0.1864 + 0.0837 + 0.018)]

= 10 x [0.031455 + 0.1743478 + 0.198736 + 2.500 x 0.6159]

= 10 x [0.031455 + 0.1743478 + 0.1978736 + 1.53975]

= 10 x [1.9434264]

SPF = 19.434264

For F-2:

SPF = 10 x [0.0150 x 2.099 + 0.0817 x 1.137 + 0.2874 x 2.268 + 0.0378 x 2.503 + 0.1864 x 2.500 + 0.0837 x 2.500 + 0.0180 x 2.500]

= 10 x [0.037485 + 0.1745929 + 0.6518232 + 0.8204834 + 0.466 + 0.20925 + 0.045]

= 10 x [2.35356345]

SPF = 23.536345

Figure 01: UV-VIS Absorbance spectra of absorbance VS wavelength from 200 – 400 nm of F-1

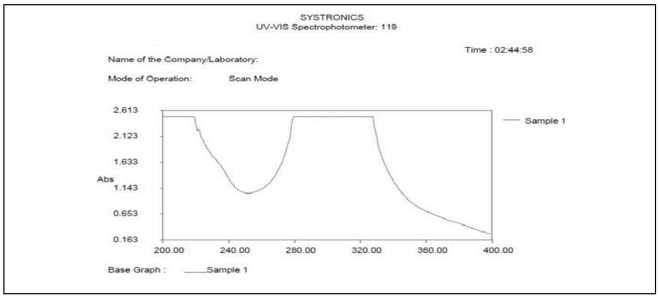
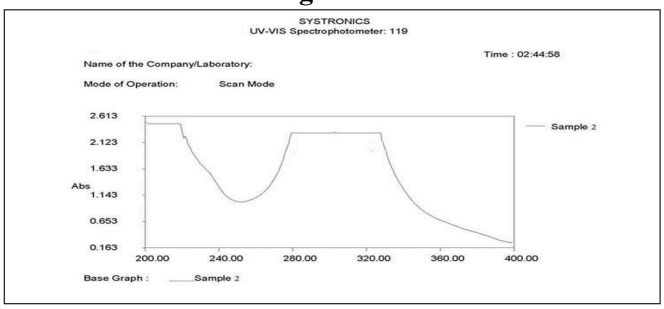


Figure 02: UV-VIS Absorbance spectra of absorbance VS wavelength from 200 – 400 nm of F-2



Conclusion

The study examines the effectiveness of aloe vera and resveratrol in the form of herbosome lotion to prevent sunburn. Both F1 and F2 were tested for their physicochemical properties and SPF after being made by varying the amount of composition. According to the study, herbosomal sunscreen lotion F2 was shown to be more stable and to have a higher SPF value. As the formulations with herbosome were found to possess SPF in the range of 13 to 18, they can be used on normal skin to prevent sunburns. Further, the formulations were proven to be non-irritant, containing fewer active ingredients, which differentiates them from synthetic sunscreens. It is possible that the current research will help treat sunburns produced by UV light exposure. Compared to other simple sunscreen lotions, herbosome lotion can help the active ingredients, such as those in aloe vera and resveratrol, penetrate deeper into the skin. Aloe vera gel can sometimes lose its potency when exposed to light, air, or other environmental factors. Herbosomes can help stabilise aloe vera, protecting it from degradation and maintaining its beneficial properties over time.

In summary, herbosomes help optimise the delivery and effectiveness of aloe vera and resveratrol in sunscreen formulations, improving both the sunscreen's protective properties and the skin-soothing benefits of aloe vera.

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